Published in final edited form as:

Haemophilia. 2013 May ; 19(3): 426–431. doi:10.1111/hae.12073.

Prevalence of clinical hip abnormalities in haemophilia A and B: an analysis of the UDC database

D. KELLY[*,1], **Q. C. ZHANG**[†], **J. M. SOUCIE**[†], **M. MANCO-JOHNSON**[‡], and **D. DIMICHELE**[*,2] **FOR THE JOINT OUTCOME SUBCOMMITTEE OF THE COORDINATING COMMITTEE FOR THE UNIVERSAL DATA COLLECTION DATABASE AND THE HEMOPHILIA TREATMENT CENTER NETWORK INVESTIGATORS**

[*]Weill Cornell Medical College, New York, NY, USA

[†]Division of Blood Disorders, National Center on Birth Defects and Developmental Disabilities, CDC, Atlanta, GA, USA

[‡]Mountain States Regional Hemophilia and Thrombosis Center, University of Colorado, Denver and Children's Hospital, Aurora, CO, USA

Summary

Clinical hip abnormalities, secondary to recurrent joint and/or muscle bleeding in persons with haemophilia, have not been well characterized and have the potential for significant morbidity. We aimed to examine the prevalence of clinical hip abnormalities in the US haemophilia population and to explore associations between these findings and putative risk factors. We conducted a study of hip abnormalities of 8192 subjects aged 2–69 years with haemophilia A and haemophilia B (54% of haemophilia A and haemophilia B are severe) currently enrolled in the Universal Data Collection (UDC) database. Associations between hip abnormality and type/severity of haemophilia A/B, current age, history of high-titre (≥5 BU) inhibitor (HTinh), concomitant ankle (AA) and knee arthropathy (KA), overweight and obesity and prophylaxis were examined using logistic regression. Overall prevalence of hip abnormality at the last recorded UDC visit for all subjects was 16.7%. Haemophilia A (aOR = 1.3, 1.0–1.4), severe haemophilia (aOR = 1.3, 1.0–1.5), a history of HTinh (aOR = 1.4, 1.1–1.7), and concomitant AA (aOR = 1.7, 1.4–1.9) were each independently associated with hip abnormality. Older age (45–69 years) was significantly associated with hip abnormality prevalence only in subjects with KA (aOR = 3.4, 1.9–5.9). The presence of overweight (aOR = 1.4, 1.1–1.8) and obesity (aOR = 2.1, 1.6–2.8) was associated with hip abnormality only among subjects without KA. Hip abnormality prevalence was not influenced by prophylaxis (aOR = 0.9, 0.8–1.1). These data suggest that hip abnormalities in US patients with

Correspondence: Daniel Kelly, MD, Division of Critical Care Medicine, Department of Anesthesia, Perioperative and Pain Medicine, Boston Children's Hospital, 300 Longwood Avenue, Bader 620, Boston, MA 02115, USA. Tel.: +(617) 355 7327; fax: (617) 730 0453; daniel.kelly@childrens.harvard.edu.

[1]Current address: Division of Critical Care Medicine Department of Anesthesia Perioperative and Pain Medicine at Boston Children's Hospital.

[2]Current address: Division of Blood Diseases and Resources at the National Heart Lung and Blood Institute.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Disclosures

The authors stated that they had no interests which might be perceived as posing a conflict or bias.

haemophilia are associated with haemophilia severity and type, HTinh, concomitant AA and, depending on the presence or absence of KA, advancing age and obesity.

Keywords

arthropathy; haemophilia; hip joint; joint disease; target joint

Introduction

The development of chronic pain and limited motion secondary to recurrent joint and muscle bleeding causes significant morbidity in persons with haemophilia. Overall, patients with the musculoskeletal complications of haemophilia are more likely to have had early and recurrent ankle, knee or elbow haemarthroses; hip abnormalities, when they occur, generally manifest at an older age [1]. Although less common, hip abnormalities serve as a significant source of impaired mobility. Joint and muscle bleeding around the hip could pose a particularly significant problem in the paediatric population as prior studies indicate that arthropathy developing in childhood results in more severely destructive hip disease than that occurring after 20 years of age [2].

Although the risk factors for hip dysfunction in haemophilia remain poorly understood, ancillary factors known to generally affect haemophilic joint morbidity may impact this phenomenon [3,4]. Prophylactic factor administration has been shown to prevent joint destruction and to decrease the frequency of all joint haemorrhage [5–8]. However, among patients with severe haemophilia who develop high-titre inhibitors of ≥5 Bethesda Units (BU), effective prophylaxis is more difficult to achieve and overall morbidity, including haemophilic arthropathy, is often more pronounced [4,9]. Furthermore, in the US children and adults exhibit an increasingly sedentary lifestyle with an associated increased likelihood of obesity [10]. The potential influence of this national trend on range of motion (ROM), and secondarily, on predisposition to haemorrhage, in joints is concerning. Recently published studies demonstrated that obese males with haemophilia A had lower ROM and a faster rate of loss of joint mobility in the lower limbs compared with those with a normal body mass index (BMI) [3,11]. The impact of knee and ankle arthropathy on hip disease in haemophilia has not been documented to date.

Based on recent institutional experience with hip haemarthroses in several children aged 1–10 years of age, we sought to examine the national prevalence of hip abnormalities in US children and adults with severe, moderate and mild haemophilia A and haemophilia B who are currently enrolled in the Center for Disease Control and Prevention's Universal Data Collection (UDC) database. The UDC project is a surveillance database of over 14 000 patients with haemophilia treated at federally funded Hemophilia Treatment Centers (HTC), and includes joint ROM on 96% of enrolled subjects [12,13]. We also sought to evaluate the prevalence of hip abnormalities relative to potentially important comorbidities including advancing age; a history of high-titre inhibitor; concomitant prevalence of abnormal ROM in knee and ankle and elevated BMI. A better understanding of this haemophilic complication and the identification of its potential risk factors could allow for targeted

therapy and lifestyle adjustments aimed at reducing risk of hip joint abnormality and associated morbidity.

Methods

The UDC project, initiated in 1998, is a surveillance database containing demographic and clinical information on over 14 000 patients with haemophilia treated at a network of specialized HTC, and includes joint ROM measurements on 96% of enrolled subjects [12,13]. All male UDC participants with severe, moderate and mild haemophilia A and haemophilia B, enrolled in the UDC database between 1998 and 2008, and aged 2–69 years at the time of their last visit, were eligible for inclusion in the study. The study examined the relationship between demographic and clinical characteristics of the population and the prevalence of documented or suggested hip abnormalities. Hip abnormality was defined by: (i) a deficit in hip ROM at the last recorded UDC visit, and/or (ii) designation of the hip as a target joint at the last recorded visit, and/or (iii) joint replacement/fusion as recorded at any UDC visit during the study period. Deficit in hip ROM was determined for each subject and defined as a ROM that was at least 3 standard deviations below the mean normal ROM for hip flexion and/or extension for his age group individuals [14]. Joint-specific bleeding data, including bleeding site and frequency, are not captured in the UDC data set. To better define hip abnormality in the absence of such data, subjects with bilateral hip ROM deficits were excluded from the analysis unless the deficit was corroborated by concomitant target joint designation or hip replacement in at least one hip joint. In this way, we attempted to minimize the likelihood of inappropriately including bilateral deficits in hip ROM not due to haemorrhage, (e.g. muscle tightness, increased body mass, inactivity), in the analysis. Similarly, the lack of site-specific bleeding data precluded the exclusion from analysis of residual deficits in hip ROM from prior hip flexor or extensor muscle and connective tissue haemorrhage. Therefore, we chose to use the term ‘hip abnormality’ to encompass both the intra-articular and extra-articular complications of bleeding into the hip area.

Hip abnormality was examined relative to the following comorbidity variables: advancing age; history of high-titre inhibitor; presence of knee and ankle arthropathy and BMI. In addition, haemophilia type and severity were examined. Finally, the prevalence of hip abnormalities was examined in subjects with severe haemophilia A and haemophilia B and no history of an inhibitor who were receiving continuous prophylaxis at the first UDC visit and compared with those subjects who received only on-demand (episodic) treatment.

Definition of variables

Knee or ankle arthropathy was defined as the presence of either abnormal knee/ankle ROM or designation of the knee/ankle as a target joint at the visit before the last recorded UDC visit or indication at any UDC visit that any knee replacement or ankle fusion had been performed. This served as a surrogate marker for overall severity of arthropathy. Abnormal ROM was defined as a decrease of >3 standard deviations below the mean age-specific normal ROM for knee flexion and/or extension, and ankle dorsiflexion and/or plantar flexion [14].

High-titre inhibitor positivity was defined by at least 1 historical peak titre of >5 BU recorded at any time during the data collection period [15].

BMI (weight in kilograms/height in metres squared) was calculated at baseline to categorize weight status. Adults aged 20–69 years with BMIs of 12 to <25 were considered underweight to normal; those with 25 to <30 were classified as overweight and those with ≥30 were determined to be obese. For children and adolescents aged 2–19 years, we used the US Centers for Disease Control and Prevention (CDC) recommended percentile guidelines for children's BMI classification, which takes into consideration normal differences in body fat between boys and girls at various ages, as follows: underweight to normal weight (<5th–84th percentile); overweight (85th–95th percentile) and obese (>95th percentile) [16].

Prophylaxis was defined as having received treatment products on a regular schedule for an indefinite period to prevent any and all bleeding. This definition would encompass current definitions of primary and secondary prophylaxis, which could not be distinguished in this data set. Subjects who had not received continuous prophylaxis at time of the first UDC visit were defined as receiving episodic (on-demand) therapy.

Statistical analysis

The prevalence of hip abnormality and its components were calculated for each age and severity level. Pearson's chi-squared tests or Fisher exact test was used to assess the statistical significance of associations between HAbn and levels of demographic and clinical characteristics.

Multivariate associations were analysed using logistic regression analysis. The logistic regression model included all of the studied risk factors and statistical interactions between variables were assessed by entering interaction terms in the model. Adjusted odds ratios (aOR) of hip abnormality and 95% confidence intervals were computed. Stratified odds ratios were presented when statistically significant interaction (effect modification) was identified. All statistical analyses were based on two-sided tests with a significance level of 0.05, and conducted using SAS 9.2 (SAS Institute, Cary, NC, USA).

Results

The study included 8192 subjects aged 2–69 years (51% aged 2–19 years) with haemophilia A (78%) and haemophilia B of all severities (54% are severe) enrolled in the UDC database between 1998 and 2008. Hip abnormality was found in 1372/8192 (17%) of all evaluated haemophilic subjects (Table 1). The prevalence of hip abnormality in children aged 2–8 years was 7% (94/1328), and was defined solely by abnormal hip ROM in 87/94 (93%) of the youngest subjects. Hip abnormality defined on the basis of hip replacement or target joints was much less frequent and occurred almost exclusively in subjects over the age of 20 years.

Associations between subject demographic and clinical characteristics and hip abnormality are shown in Table 2. A significant increase in the prevalence of hip abnormality was noted in association with increasing age and haemophilia severity ($P < 0.0001$), in subjects with

haemophilia A as compared with haemophilia B (18% vs. 14% $P = 0.0003$), among subjects with a positive history of a high-titre inhibitor (22% vs. 16%, $P = 0.0007$), among those who were overweight or obese as compared with non-overweight (20%, 24% vs. 16% $P < 0.0001$) and among those with concomitant knee (25% vs. 11%, $P < 0.0001$) and ankle arthropathy (24% vs. 11%, $P < 0.0001$) (Table 2). However, there was no significant difference in hip abnormalities among those subjects receiving continuous prophylaxis (17%) when compared with those who had received only episodic (on-demand) therapy (16%, $P = 0.47$).

To evaluate the independent associations between the studied demographic and clinical characteristics and hip abnormality, a logistic regression model was utilized. We found statistical interaction (effect modification) between concomitant knee arthropathy and both age and BMI. This meant that the strength of the associations between age and hip abnormality and separately, BMI and hip abnormality, was different depending on the presence or absence of knee arthropathy. Therefore, we present stratum-specific odds ratios for both age and BMI in Table 3.

Haemophilia A (aOR = 1.3, 1.0–1.4), severe haemophilia (aOR = 1.3, 1.0–1.5), a high-titre inhibitor (aOR = 1.4, 1.1–1.7) and concomitant ankle arthropathy (aOR = 1.7, 1.4–1.9) were each independently associated with the presence of hip abnormality (Table 3). Among subjects without concomitant knee arthropathy, subjects who were 9–19 years old were more likely than those who were 2–8 years old to have hip abnormalities (aOR = 1.7, 1.2–2.5). In contrast, among those with knee arthropathy only the 45–69-year-old subjects were more likely than the youngest subjects to have hip abnormalities (aOR = 3.4, 1.9–5.9).

Concomitant knee arthropathy also influenced associations between BMI and hip abnormality (Table 3). Overweight (aOR = 1.4, 1.1–1.8) and obese subjects (aOR = 2.1, 1.6–2.8) without knee arthropathy were 1.4 times and 2 times more likely than their normal weight counterparts to have hip abnormalities. However, there was not a significantly increased likelihood of hip abnormalities among either overweight or obese subjects who also had knee arthropathy.

Discussion

The prevalence of hip abnormalities in haemophilia has not been characterized in the context of the availability of more intensive coagulation factor replacement therapy. In this study, we performed such an evaluation in a US haemophilia cohort that has undergone surveillance for the prevalence of disease- and treatment-related complications of the disorder. However, as discussed in the Methods section of this manuscript, the definitions of hip dysfunction required modification to compensate for the lack of site-specific bleeding data. The term ‘hip abnormality’ was therefore chosen to encompass both the intra-articular and extra-articular morbidity that could contribute to unilateral loss of ROM.

Within the context of the methodological limitations, we report an overall prevalence of hip abnormality in this US haemophilia population of 16.7%. This is a lower prevalence than that observed in this cohort for both knee (42%) and ankle (45%) arthropathy, but possibly

more frequent than anticipated in persons with haemophilia. Furthermore, the long-term morbidity associated with overt hip arthropathy appears to be significant. Among older adults in the study sample, 5% had experienced target joint bleeding in a hip and 7% required a replacement of at least one hip.

Our initial clinical observation of hip abnormality in very young children was corroborated by the observed prevalence of 7% in the youngest study sub-cohort. However, the low hip abnormality prevalence was somewhat reassuring. Nonetheless, as developing joints may be more prone to destructive arthropathy with minimal bleeding [17], these data also suggest that caregivers should be alert to symptoms of local pain and unilateral decreased hip ROM as possible signs of hip haemarthrosis or haemorrhage into large muscle groups in the area (e.g. iliopsoas), even in a very young child without other lower extremity arthropathy.

Although the database did not allow us to examine predisposing events or risk factors, we were able to evaluate potentially associated comorbid conditions, related and unrelated to haemophilia. Not surprisingly, haemophilia severity and positive high-titre inhibitor status, variables known to be associated with overall increased orthopaedic morbidity, were also associated with significantly higher hip abnormality prevalence in this study. The increased association of hip abnormality with underlying haemophilia A when compared with haemophilia B corroborates the Italian observations of Iorio *et al.* [18]. However, prophylaxis intervention was not a significant modifying factor in our study. This observation likely relates to the nature of a surveillance data collection limited by nomenclature adopted prior to the widespread use of prophylaxis in the United States. Although a more precise classification was unavailable for inclusion in our analysis, it remains likely that much of the ‘continuous’ prophylactic use of factor in our data set reflected the late initiation of secondary prophylaxis similarly described in the international orthopaedic study by Aledort *et al.* [7].

In this US cohort, 20% of subjects were overweight and 12% were obese, according to well-defined criteria. In excluding bilateral decreased hip ROM that may have been due to elevated BMI alone, we were able to examine and ascertain a very strong independent association between hip abnormality and this variable, particularly obesity. This association remained highly significant, except in the presence of concomitant knee arthropathy. These results would suggest that the impact of knee arthropathy on the development of hip abnormalities is more significant than overweight and obesity for patients in whom both conditions coexist. Consequently, the association between excess weight and hip abnormalities is best observed in patients without knee arthropathy as a complication of their haemophilia.

The relationship between elevated BMI and hip abnormality is likely complex; each condition has the potential to influence the other. Nonetheless, the growing rates of obesity among the general population demonstrate an alarming trend [19,20]. Based on previously published data, this trend may be even more problematic among those individuals with haemophilia [11]. Several of the comorbidities associated with hip abnormality cannot be easily manipulated; however, altering lifestyle choices to maintain a normal BMI for age

could represent an important means of maintaining overall orthopaedic health in persons with haemophilia.

The significant direct correlation observed between hip abnormality and both advancing age as well as concomitant lower extremity arthropathy was also expected. However, we did not anticipate the strength of the association between hip abnormality and knee arthropathy. Concomitant knee arthropathy appeared to be primarily responsible for the significant age-related association with hip abnormality in the adult subgroups in our study. The interpretation of these findings is again limited by the nature of the data. Nonetheless, these data do suggest the potential importance of preventing knee arthropathy in the maintenance of normal hip ROM.

The subgroup of haemophilia subjects aged 9–19 years warrants further discussion. The prevalence of hip abnormality in this age group was 15%, double that observed in the youngest cohort. As with the youngest subjects, the majority of the hip abnormality in this sub-group (96%) was defined by significant unilateral loss of hip ROM. Importantly, absent knee or ankle arthropathy did not appear to modify this significant age effect. Given that our definition of hip abnormality encompassed limitations in both intraarticular hip and extra-articular muscle and connective tissue morbidity, these subjects may have experienced altered hip mechanics from more muscle (including iliopsoas) and groin tissue bleeding associated with greater sports-related activity, parameters that we could not measure. In addition, in a prior recent study of the UDC cohort, subjects aged 2–20 were noted to have a 15% and 17.4% prevalence of overweight and obesity, respectively [11]. Both states of elevated BMI were noted in that study to independently and statistically correlate with loss of ROM over time [11]. Obesity prevalence in the younger subjects trends higher than that for this study population as a whole (12%). Although bilateral loss of hip ROM was excluded in this study to minimize the effect of BMI alone, increased BMI compared with the cohort as a whole could have been partially responsible for the results observed in this age group.

Limitations

In addition to the study limitations already described, the UDC database could not identify other potential confounders of our analysis. These included unrelated ancillary conditions that may specifically affect hip ROM (e.g. HLA-B27 spondylarthropathy, Gaucher Disease and Legg-Calve-Perthes Disease). However, the most common among these is Legg-Calve-Perthes disease which occurs with an estimated frequency of 0.4–15.4/100 000 among patients less than 15 years of age and is unlikely to have significantly affected the epidemiology of loss of hip ROM in a haemophilia population [11,21]. The most potentially confounding condition among haemophilia-related causes of loss of hip ROM would indeed be iliopsoas muscle haemorrhage, which has been reported to occur at an annual incidence rate of 2.9/1000 patients with severe or moderate haemophilia A [22]. The potential confounding effect of this variable has been discussed.

Conclusion

We conclude that among subjects enrolled in the UDC database, hip abnormality accounts for an appreciable amount of orthopaedic morbidity. As might have been anticipated, advancing age, haemophilia severity and type, positive high-titre inhibitor status and elevated BMI were all factors associated with increased prevalence of hip abnormality, as defined in this study. Surprisingly, concomitant knee arthropathy proved to be a strongly associated comorbidity. However, given the limitations of this study, prospective longitudinal data collection that includes joint-specific haemorrhage as well as more robust markers of arthropathy will be required to both confirm the prevalence of specific hip arthropathy and further define its risk factors, particularly in the younger population in whom early intervention would minimize long-term morbidity.

Acknowledgments

DK and DD developed the initial concept as well as the study design. MS and CZ conducted the statistical analysis. DK and DD served as primary authors; MS, CZ, MMJ participated in discussion of analyses, authored segments of the manuscript and participated in critiquing drafts. DD provided supervision, mentoring and administrative support.

References

1. Wallny T, Brackmann HH, Seuser A, Diedrich O, Kraft CN. Haemophilic arthropathy of the hip in children–prognosis and longterm follow-up. Haemophilia. 2003; 9:197–201. [PubMed: 12614372]
2. Miles J, Rodríguez-Merchán EC, Goddard NJ. The impact of haemophilia on the success of total hip arthroplasty. Haemophilia. 2008; 14:81–4. [PubMed: 18034823]
3. Soucie JM, Cianfrini C, Janco RL, et al. Joint range-of-motion limitations among young males with hemophilia: prevalence and risk factors. Blood. 2004; 1:103.
4. Jansen NWD, Roosendaal G, Lafeber FPJG. Understanding haemophilic arthropathy: an exploration of current open issues. Br J Haematol. 2008; 143:632–40. [PubMed: 18950457]
5. Manco-Johnson MJ, Abshire TC, Shapiro AD, et al. Prophylaxis versus episodic treatment to prevent joint disease in boys with severe hemophilia. N Engl J Med. 2007; 9:357.
6. Petrini P, Lindvall N, Egberg N, Blombäck M. Prophylaxis with factor concentrates in preventing hemophilic arthropathy. Am J Pediatr Hematol Oncol. 1991; 13:280–7. [PubMed: 1793153]
7. Aledort LM, Haschmeyer RH, Pettersson H. A longitudinal study of orthopaedic outcomes for severe factor-VIII-deficient haemophiliacs. The Orthopaedic Outcome Study Group. J InternMed. 1994; 236:391–9.
8. Nilsson IM, Berntorp E, Löfqvist T, Pettersson H. Twenty-five years' experience of prophylactic treatment in severe haemophilia A and B. J Intern Med. 1992; 232:25–32. [PubMed: 1640190]
9. Scharrer I, Bray GL, Neutzling O. Incidence of inhibitors in haemophilia A patients–a review of recent studies of recombinant and plasma-derived factor VIII concentrates. Haemophilia. 1999; 5:145–54. [PubMed: 10444280]
10. Koplan JP, Liverman CT, Kraak VI. Committee on Prevention of Obesity in Children and Youth: preventing childhood obesity: health in the balance: executive summary. J Am Diet Assoc. 2005; 105:131–8. [PubMed: 15635359]
11. Soucie JM, Wang C, Siddiqi A, et al. The longitudinal effect of body adiposity on joint mobility in young males with Haemophilia A. Haemophilia. 2011; 17:196–203. [PubMed: 21332880]
12. Soucie JM, McAlister S, McClellan A, Oakley M, Su Y. The universal data collection surveillance system for rare bleeding disorders. Am J Prev Med. 2010; 38:S475–81. [PubMed: 20331946]
13. Centers for Disease Control and Prevention (CDC). Blood safety monitoring among persons with bleeding disorders–United States, May 1998–June 2002. MMWR Morb Mortal Wkly Rep. 2003; 51:1152–4. [PubMed: 12553567]

14. Soucie JM, Wang C, Forsyth A, et al. Range of motion measurements: reference values and a database for comparison studies. Haemophilia. 2011; 17:500–7. [PubMed: 21070485]
15. White GC, Rosendaal F, Aledort LM, et al. Definitions in hemophilia. Recommendation of the scientific subcommittee on factor VIII and factor IX of the scientific and standardization committee of the International Society on Thrombosis and Haemostasis. Thromb Haemost. 2001; 85:560. [PubMed: 11307831]
16. Kuczmarski RJ, Ogden CL, Guo SS, et al. 2000 CDC growth charts for the United States: methods and development. Vital Health Stat. 2002; 11:1–190.
17. Valentino LA, Hakobyan N, Enockson C, et al. Exploring the biological basis of haemophilic joint disease: experimental studies. Haemophilia. 2012; 18:310–8. [PubMed: 22044636]
18. Tagariello G, Iorio A, Santagostino E, et al. Comparison of the rates of joint arthroplasty in patients with severe factor VIII and IX deficiency: an index of different clinical severity of the 2 coagulation disorders. Blood. 2009; 23:114.
19. Ogden CL, Carroll MD, Flegal KM. High body mass index for age among US children and adolescents, 2003–2006. JAMA. 2008; 299:2401–5. [PubMed: 18505949]
20. Wang Y, Lobstein T. Worldwide trends in childhood overweight and obesity. Int J Pediatr Obes. 2006; 1:11–25. [PubMed: 17902211]
21. Perry DC, Hall AJ. The epidemiology and etiology of Perthes disease. Orthop Clin North Am. 2011; 42:279–83. v. [PubMed: 21742139]
22. Dauty M, Sigaud M, Trossaërt M, Fressinaud E, Letenneur J, Dubois C. Iliopsoas hematoma in patients with hemophilia: a single-center study. Joint Bone Spine. 2007; 74:179–83. [PubMed: 17336570]

Haemophilia. Author manuscript; available in PMC 2015 June 15.

Table 1

Hip abnormality prevalence by abnormal component[†] and subject age and haemophilia severity.

	Total# evaluated (*N* = 8192) ***N* (%)**	**Hip abnormality (*N* = 1372)** ***N* (%)**	**Hip abnormal ROM component (*N* = 1229)** ***N* (%)**	**Hip replacement component (*N* = 104)** ***N* (%)**	**Hip target joint component (*N* = 207)** ***N* (%)**
Age					
2–8 years	1328 (16)	94 (7)*	88 (7)*	0*	7 (1)*
9–19 years	2861 (35)	444 (16)	424 (15)	0	35 (1)
20–44 years	2945 (36)	537 (18)	464 (16)	31 (1)	110 (4)
45–69 years	1058 (13)	297 (28)	253 (25)	73 (7)	55 (5)
Haemophilia severity					
Mild	1844 (23)	226 (12)*	208 (11)*	16 (1)*	23 (1)*
Moderate	1942 (24)	312 (16)	289 (15)	22 (1)	26 (1)
Severe	4406 (54)	834 (19)	732 (17)	66 (2)	158 (4)

*P value <0.0001 from Pearson's chi-squared test or Fisher exact test for increasing hip abnormality prevalence with increasing age and severity.

†Hip abnormality was simultaneously defined by more than one component in multiple subjects.

Table 2

Comparison of demographic and clinical characteristics in patients with and without hip abnormality.

	Total (*N* = 8192) *N* (% of column)	Hip abnormality (*N* = 1372) *N* (% of row)	Normal (*N* = 6820) *N* (% of row)	P value*
Age				
2–8 years	1328 (16)	94 (7)	1234 (93)	<0.0001
9–19 years	2861 (35)	444 (16)	2417 (84)	
20–44 years	2945 (36)	537 (18)	2408 (82)	
45–69 years	1058 (13)	297 (28)	761 (72)	
Haemophilia type				
Haemophilia A	6419 (78)	1125 (18)	5294 (82)	0.0003
Haemophilia B	1773 (22)	247 (14)	1526 (86)	
Haemophilia severity				
Mild	1844 (23)	226 (12)	1618 (88)	<0.0001
Moderate	1942 (24)	312 (16)	1630 (84)	
Severe	4406 (54)	834 (19)	3572 (81)	
Positive history of a high-titre inhibitor				
No	7630 (93)	1248 (16)	6382 (84)	0.0007
Yes	562 (7)	124 (22)	438 (78)	
Baseline BMI†				
Normal	5094 (69)	806 (16)	4288 (84)	<0.0001
Overweight	1446 (20)	292 (20)	1154 (80)	
Obese	851 (12)	200 (24)	651 (76)	
Concomitant knee arthropathy†				
No	4618 (58)	519 (11)	4099 (89)	<0.0001
Yes	3338 (42)	836 (25)	2502 (75)	
Concomitant ankle arthropathy†				
No	4318 (55)	485 (11)	3833 (89)	<0.0001
Yes	3602 (45)	865 (24)	2737 (76)	
Prophylaxis				
No	2024 (25)	328 (16)	1696 (84)	0.4713
Yes	6168 (75)	1044 (17)	5124 (83)	

* *P* value is calculated by Pearson's chi-squared test.

† Relevant data missing for some subjects.

Table 3

Independent associations between hip abnormality and subject characteristics by multiple logistic regression.

	aOR (95% CI)	*P* value
Age (vs. 2–8 years)		
Without concomitant knee arthropathy		
9–19 years	1.7 (1.2–2.5)	0.002
20–44 years	1.4 (1.0–2.0)	0.063
45–69 years	1.4 (0.9–2.1)	0.206
With concomitant knee arthropathy		
9–19 years	1.7 (1.0–2.9)	0.069
20–44 years	1.7 (1.0–2.9)	0.060
45–69 years	3.4 (1.9–5.9)	<0.0001
Haemophilia A (vs. B)	1.3 (1.0–1,4)	0.028
Haemophilia severity (vs. mild)		
Moderate	1.2 (1.0–1.5)	0.062
Severe	1.3 (1.0–1.5)	0.022
High-titre inhibitor	1.4 (1.1–1.7)	0.010
Elevated BMI (vs. normal)		
Without concomitant knee arthropathy		
Overweight	1.4 (1.1–1.8)	0.014
Obese	2.1 (1.6–2.8)	<0.0001
With concomitant knee arthropathy		
Overweight	1.1 (0.9–1.3)	0.537
Obese	1.2 (0.9–1.5)	0.201
Concomitant Ankle arthropathy	1.7 (1.4–1.9)	<0.0001
Prophylaxis	0.9 (0.8–1.1)	0.288

aOR(95% CI): adjusted odds ratio and 95% confidence interval.